Section of Epidemiology and State Medicine

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DISCUSSION: INFLUENZA 1951

Dr. W. H. Bradley: There are three phenomena which should be considered as part of the background of any epidemic of influenza.

(1) *The periodicity and incidence of the disease in past years.*—A chart was shown which has been compiled at the Ministry of Health by addition week by week of the influenza deaths certified in London and the great towns ever since the second wave of the pandemic of 1918–1919. The type of virus indicated on the chart was that isolated in the epidemic since 1933 when Smith, Andrewes and Laidlaw discovered how to handle influenza virus. We have no information concerning the viruses causing influenza before that year—1933.

(2) *The nadir of* 1948.—The second phenomenon is the absence of influenza in 1948. This was the outstanding epidemiological feature in that year which seems to have been unique in this respect in recent history. The deaths ascribed to influenza in the first quarter of the year 1948 in the 126 great towns of England and Wales numbered 280 only (Fig. 1). This was less than one-seventh of the average in the preceding ten years which by comparison with the years from 1918 to 1938 had not included severe influenza. In no year between 1918 and 1938 was the number of deaths from influenza in the first quarter less than 1,000. Since then, in 1938, 1942 and 1945 deaths numbered 869, 862 and 693 respectively. In all other years since 1938 they exceeded 1,000 in the first quarter. The first quarter figure for 1948, namely 280, was by far the lowest ever recorded and in those weeks of the year when, as a rule, influenza deaths are most common and are indeed considered to be of no special significance unless they exceed 100 a week, they numbered less than 20 a week. It is doubtful if influenza virus was responsible for any of these deaths. The diagnosis of "influenza" on a death certificate is known to cover a multitude of conditions and consequently the statistics for influenza relate to an ill-defined group of diseases. Therefore, in view of the fact that during 1948 the influenza virus reference laboratories failed to recover virus from any of the material sent to them, one can fairly safely make the statement that virus influenza on any appreciable scale was absent from the country in 1948. 1948, therefore, provides a valuable base line.

Fig. 1 and Fig. 2 compare deaths from influenza and deaths, all causes, in the first quarter of 1948 and during the first part of 1951. This gives some idea of the total effect

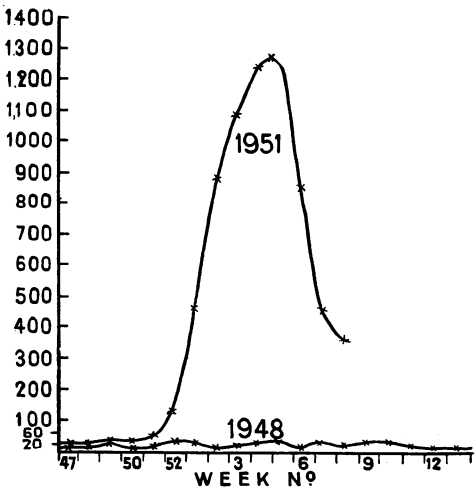


FIG. 1.—Deaths from influenza in Great Towns (England and Wales), 1948 and 1951.

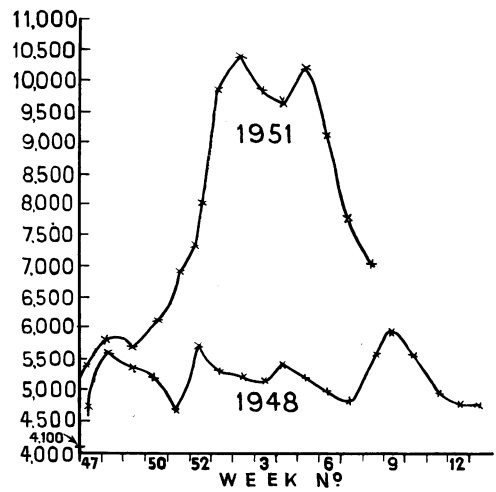


FIG. 2.—Total deaths (all causes) in Great Towns (England and Wales), 1948 and 1951.

of virus influenza and it should be noted that, in some weeks during the 1951 epidemic, the total deaths in the 126 great towns of England and Wales were twice as many and more than 5,000 in excess of the corresponding week in 1948. Obviously the problem we are discussing this evening is a very important one.

(3) *The pathology.*—The third phenomenon I wish to mention is the remarkable specificity of influenza virus for the cells of the respiratory epithelium. Professor Mulder of Leyden (1949) published photographs from a case of influenza virus A infection on the third day of disease. Fezekas de St. Groth (in press), working with Sir McFarlane Burnet in Melbourne, has fairly clearly demonstrated that multiplication of the virus is limited to the cells lining the respiratory tract and that there is no involvement of anything but the respiratory epithelium of the bronchial tree including the smallest bronchiole. Sir McFarlane Burnet's construction of the possibility is that virus particles lodge on the cells of the bronchial or bronchiolar epithelium. When the virus enters the cell it multiplies and, with the necrosis of the cell, a second generation of virus particles is liberated on the respiratory surface. Ciliary movement will ensure that infection spreads centripetally and not centrifugally along the respiratory passages but, apart from this, infection by influenza virus is infection over the surface of a sheet of specifically susceptible cells. Passage of virus into lymph channels undoubtedly occurs and probably small amounts reach the blood but in neither case is the virus conveyed to susceptible cells. The surface character of the infection is of importance in two ways: firstly, the toxic effects which accompany this relatively superficial damage are not due to any soluble toxins, but are probably a measure of cell damage, the symptom producing agents being soluble products from the breakdown of cells. The second point is that it seems not improbable that it takes something else to cause the more serious pulmonary lesions in influenza and that we must be prepared in discussing influenza to mention also secondary invasion with other pathogens which may have an independent epidemiology.

It is, of course, obvious that the destruction of respiratory mucosa would seriously embarrass anybody whose respiratory function is already impaired. This is a characteristic of the aged who have been so seriously affected in recent weeks but it has also been noticed that in 1951 a large proportion of the deaths in younger people occurred in such cases.

The 1951 *virus.*—Dr. C. H. Andrewes of the World Influenza Centre at the National Institute for Medical Research, Mill Hill, tells me that although strains of virus isolated this year belong to type A, the comparison with other type A strains is not yet complete and it would be unwise to assume that, in fact, one type of virus only was responsible for our troubles in 1951. It is therefore too early to attempt a complete reconstruction of the epidemiology of this year's experience.

REFERENCE

MULDER, J., and VERDONK, G. J. (1949) *J. Path. Bact.*, **61**, 55.

Dr. A. Massey (Chief Medical Officer, Ministry of National Insurance) said: In connexion with influenza outbreaks, figures relating to sickness benefit claims lodged with Local Offices of the Ministry of National Insurance can give useful indications on incidence, course and geographical distribution. Canalized information became possible for the first time on the introduction of the National Insurance scheme in 1948. Formerly the information was hopelessly diffused in the records of numerous separate Approved Societies.

The M.N.I. has about 1,000 Local Offices up and down the country. Each sickness benefit claim is made at the nearest L.O., so that for all practical purposes the address of the latter represents the area of residence of the claimant. Claims are accompanied by medical certificates. At present, however, information analysed according to the certified causes of incapacity is not available; we are concerned at the moment only with that based on the total number of sickness benefit claims from all causes.

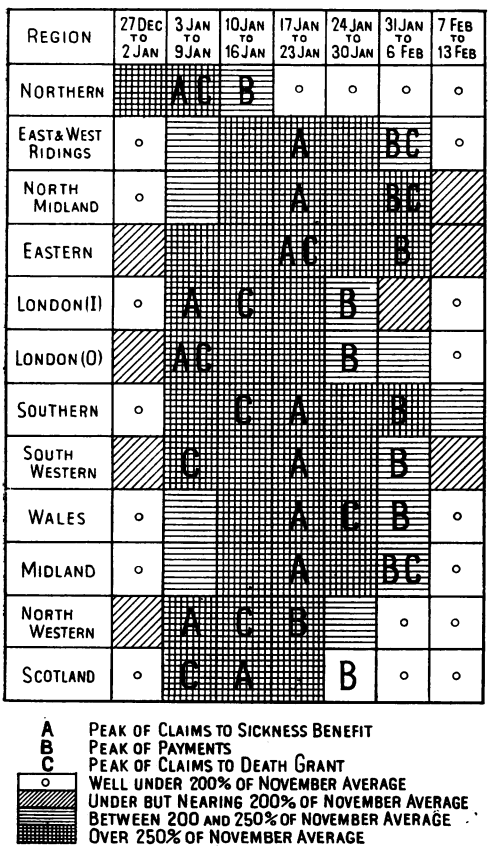
Incidence.—In the 1951 influenza epidemic, all Local Offices were required to report weekly to their Regional Offices when and to what extent the total new sickness benefit claims exceeded the November 1950 (pre-epidemic) average intake. The degrees of increase were expressed under agreed percentage headings. Each Region supplied weekly to London headquarters lists of the Local Offices reporting under each heading. Thus a national picture was available week by week of the geographical distribution and varying degrees of excess new sickness benefit claims. It was of course assumed that, during the influenza epidemic, the weight of incidence would be represented approximately by the amount by which the numbers of claims exceeded the ordinary winter average. The highest increases in claims—400%—were noted in the North West and later in Wales.

Of the three classes of insured persons two, namely employed and self-employed, are eligible for sickness benefit. These number about 22,700,000. The total of new sickness

benefit claims from all causes received in the first eight weeks of 1951—for all intents and purposes the period of the epidemic—was 2,561,600: this compares with a figure of 1,168,000 which would represent eight weeks' claims based on the November 1950 rate. Thus it appears that some 1,393,600 cases of influenza occurred (and claimed sickness benefit) among 22,700,000 at risk, or about 6%. This is rough and ready reckoning. But of course influenza is not notifiable and any indications of incidence are useful.

Arrangements were made some time ago whereby medical officers of health of counties and county boroughs can obtain on request from M.N.I. Regional Offices the weekly numbers of new sickness benefit claims reaching Local Offices in their areas. These figures have proved useful in indicating influenza trends.

Course and distribution.—The course of the epidemic judged by the trends of new sickness benefit claims is shown in Fig. 2. The peak was reached in the week ended 23.1.51 with 440,000 claims as compared with 146,000 in an average winter week. The first upward burst in new claims occurred in mid-December 1950 in the Newcastle area, and almost simultaneously the Aberdeen office reported a sharp increase. This fits the idea that the outbreak got a first footing in Great Britain through travel communications from Scandinavia.



← FIG. 1.—Chart of the progress of the epidemic by regions, 1951.

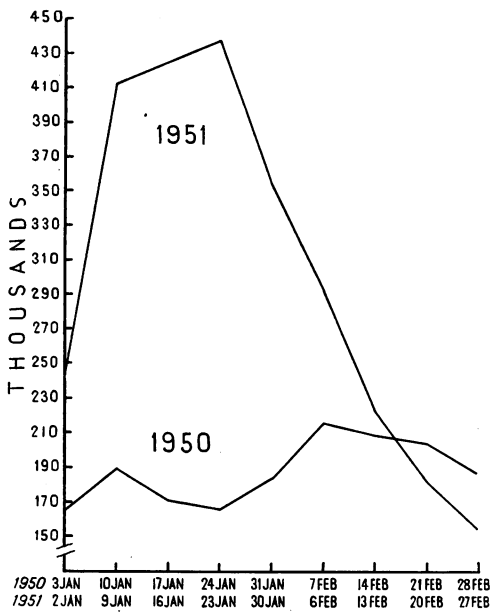


FIG. 2.—Sickness benefit claims received (Gt. Britain), 1950 and 1951.

Studied through the pattern of local offices in the regions, at least one region produced evidence to show some system in the local movements of the infection. But for the country as a whole no regular large-scale design relating to the paths of the infection can be traced. Fig. 1 shows when the peak of sickness benefit claims occurred in each region. The outbreak assumed epidemic proportions first in the north-east (northern region), and next in order came the north-west, London and Scotland. Thereafter the outbreak appeared simultaneously in various parts of the country.

Mortality.—The peak of death claims for the country as a whole usually followed a week or so after that of sickness benefit claims. In the southern and south-western regions and in Scotland, however, the peak of death claims came first (Fig. 1).

The subject of influenza mortality is dealt with fully by Dr. Logan. The fact stood

out that in a mid-epidemic week influenza deaths reached 132·1 per million in the north-west region compared with, for example, 59·7 in the north-east and 29·6 in London. Such comparisons as are possible between the 1951 outbreak and the notorious epidemic of 1918–9 show the mortality in the latter to have been seven or eight times greater than that in the former. Exceptionally, Merseyside experience this year may well compare with 1918–9.

My contribution is primarily to show that national insurance figures can be used and developed in such a way as to help the epidemiologist.

Dr. W. P. D. Logan: *Mortality Statistics.*—The deaths from influenza that I shall be discussing were those registered week by week in the Great Towns only, not in the whole of England and Wales. The total population of the Great Towns is roughly half that of England and Wales. When I speak of deaths from influenza I mean deaths in respect of which influenza was mentioned on the death certificate as being one of the conditions contributing towards death.

Fig. 1 compares mortality from influenza during the peak week of this year's epidemic (week ended February 3 with 1,269 deaths) with the largest of the previous influenza epidemics since 1918. Clearly, this year's epidemic has not been a particularly bad one. It was completely dwarfed by the peak week of the second wave of the 1918 epidemic, when the death rate was eight times as high, and was also surpassed by the epidemics of 1919, 1922, 1929, 1933 and 1943.

The total mortality from all causes during influenza epidemics rises much more than can be accounted for merely by the number of deaths certified as due to influenza. This is something that has been noticed for a very long time. Farr commented on it in regard to the influenza of 1847, mentioning, incidentally, that a similar sort of thing had happened during the Great Plague of 1665. It was discussed also by Stevenson in the Registrar-General's report on the 1918–19 epidemic, and was studied in some detail sixteen years

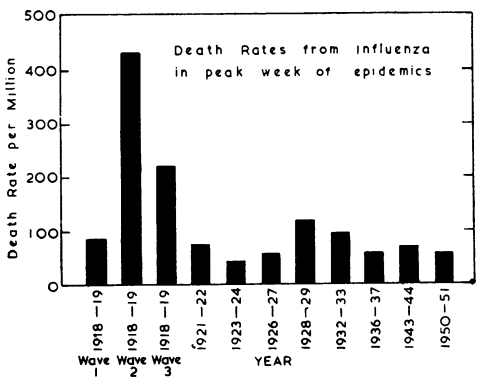


FIG. 1.—Death rates from influenza in peak week of epidemics.

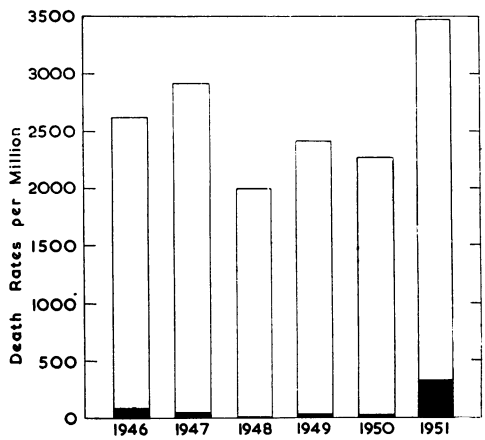


FIG. 2.—Death rates from influenza and from all causes during first eight weeks of years 1946 to 1951.

ago by Stocks. Fig. 2 compares the death-rates from influenza and from all causes in the first eight weeks of each of the last six years, and you will see that in comparison with 1950 the death-rate from influenza at the beginning of 1951 increased by about 250 per million (eight weeks), while the total death rate increased by over 1,000 per million, or four times as much. In terms of numbers of deaths there were 6,000 more deaths from influenza registered in the Great Towns in the first eight weeks of 1951 than of 1950, but the total deaths from all causes increased by 25,000. The weather during the early weeks of this year was not exceptionally cold—as it was in 1947 with the resulting increase in total mortality shown in Fig. 2—so that the increase in numbers of deaths in 1951 must be presumed due in some way to the influenza epidemic. Various suggestions have been put forward from time to time to account for the excess of deaths from all causes that regularly occurs during epidemics of influenza. The explanation that at once comes to mind is that the additional deaths were really due to influenza but were either not recognized as such or, if so recognized, were not stated by the certifier as being associated with influenza. This is not necessarily the whole story, however, and other suggestions that have been made hypothesize an "epidemic constitution" or else a separate epidemic of the secondary bacterial invaders of virus influenza.

The extraordinary age distribution of mortality in the 1918 epidemic has often been remarked upon, and Fig. 3 shows that 86 per cent of deaths in 1918 (England and Wales, whole year) were of persons under 55 years of age. This proportion fell to about 40 per cent in 1929 and 1933, to 24 per cent in 1943 and to 12 per cent during the first eight weeks of 1951 (Great Towns only). I cannot help feeling that the sulphonamides were responsible

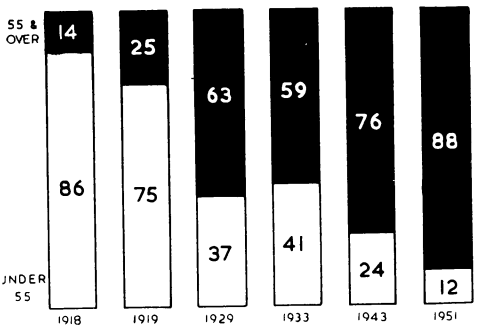


FIG. 3.—Age distribution of deaths from influenza. Percentages over and under 55 years of age.

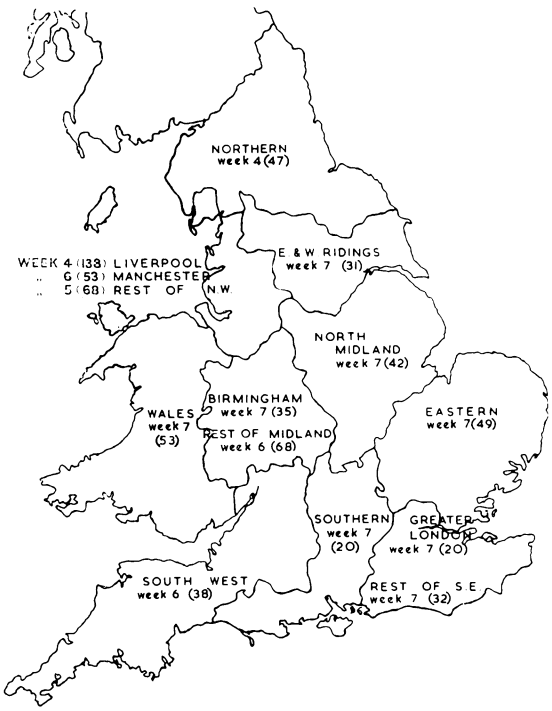


FIG. 4.—Week of maximum influenza mortality and death rate per 10,000 in the Great Towns grouped by Regions. (Weeks numbered from week ended December 23, 1950.)

for the change between 1933 and 1943 from 41 per cent to 24 per cent aged under 55, and the additional effect of penicillin may have brought about the further reduction in 1951.

The map (Fig. 4) shows the various standard regions of England and Wales. Taking week ended December 23 as the starting point, it indicates the week in which influenza deaths in the aggregate of Great Towns in each region reached their maximum, and also gives the death rate (per annum) in that week. Greater London, Birmingham, Liverpool, and Manchester have been distinguished from the other Great Towns in their regions. The epidemic reached its maximum in week 4 in two areas, the Northern Region and also in Liverpool, where the death rate was twice as high as anywhere else shown on the map. The remainder of the North West Region (except Manchester) had its peak in week 5, and in week 6 the peak occurred in Manchester, the Midland Region (except Birmingham) and the South West. In the rest of the country deaths reached their maximum in week 7. Numbers of deaths registered in individual towns give some suggestion of a separate spread of mortality down the West and down the East sides of the country, but Fig. 4 can give no evidence on this matter.

A peculiar feature noted in a diagram showing the week by week developments of various epidemics since 1918 was the tendency for a steepening of the upward slope in successive epidemics since 1922; that is to say, successive epidemics have been taking a shorter time to reach a peak (Logan and MacKay, 1951).

In the recent epidemic, one point which stands out is the excess of 25,000 deaths in the Great Towns during the first eight weeks of this year compared with last year. Remembering that the population of the Great Towns is only half that of England and Wales, it can be assumed that some 50,000 people died directly or indirectly as a result of the influenza epidemic during January and February of 1951.

REFERENCES

FARR: *in* Registrar General of England and Wales (1852) Tenth Annual Report. H.M.S.O., p. xxix.
LOGAN, W. P. D., and MACKAY, D. G. (1951) *Lancet* (i), 284.
Registrar General of England and Wales (1920) Supplement to the 81st Annual Report. H.M.S.O.
STOCKS, P. (1935) *Lancet* (ii), 386.

Dr. Andrew B. Semple (*Deputy Medical Officer of Health for the City and Port of Liverpool*): *Epidemiology of the Influenza Epidemic in Liverpool in* 1950–51.—The epidemic of influenza which occurred in Liverpool in the last week of 1950 and the early weeks of 1951, although of short duration, was for three consecutive weeks the cause of the highest weekly death roll, apart from aerial bombardment, in the city's vital statistics records since the great cholera epidemic of 1849.

History of outbreak.—The first intimation that there was some epidemic activity of influenza was information from several general practitioners in the last week of 1950 that their daily visiting lists were increasing to an unusually high figure for the time of year. It would appear that this increase started just after Christmas and the beginning of the epidemic in Liverpool was approximately December 27, 1950. The total deaths in Liverpool for the week ended December 30, 1950, was 301 as compared with 226 for the corresponding week of 1949. The main onslaught of the epidemic struck the city in the first week of the year. As influenza is not a notifiable disease, no accurate morbidity figures were available but reports of high sickness rates from corporation departments, such as the Passenger Transport Department, clearly showed that influenza was widespread. The figures set out in Table I show the high deaths for the week ended January 6, 1951—the total deaths, 658

CITY OF LIVERPOOL—INFLUENZA EPIDEMIC

TABLE I.—TOTAL DEATHS AND DEATHS FROM RESPIRATORY AND CARDIOVASCULAR DISEASES IN AGE GROUPS

Week ended		Under 1 yr.	1–14	15–54	55–64	65–75	Over 75	Totals
	Total deaths	20	10	28	40	72	74	**244**
	Influenza and influenzal pneumonia	—	—	—	—	—	2	2
23.12.50	Other pneumonias	3	3	1	3	7	8	25
	Bronchitis	—	—	1	5	7	5	18
	Cardiovascular diseases	—	—	5	11	42	41	99
	Total deaths	13	2	48	56	86	96	**301**
	Influenza and influenzal pneumonia	—	—	2	5	7	2	16
30.12.50	Other pneumonias	3	1	1	1	5	7	18
	Bronchitis	—	—	4	12	12	8	36
	Cardiovascular diseases	—	—	15	19	38	54	126
	Total deaths	18	7	84	121	218	210	**658**
	Influenza and influenzal pneumonia	—	1	8	12	37	27	85
6.1.51	Other pneumonias	4	3	9	13	27	25	81
	Bronchitis	1	—	14	30	51	37	133
	Cardiovascular diseases	—	—	14	28	59	91	192
	Total deaths	22	12	106	155	273	326	**894**
	Influenza and influenzal pneumonia	1	—	27	35	58	81	202
13.1.51	Other pneumonias	7	3	13	13	33	42	111
	Bronchitis	2	—	13	32	52	41	140
	Cardiovascular diseases	—	—	15	45	81	100	241
	Total deaths	15	6	52	90	177	241	**581**
	Influenza and influenzal pneumonia	1	—	13	22	33	45	114
20.1.51	Other pneumonias	7	—	3	10	15	33	68
	Bronchitis	2	—	5	19	36	35	97
	Cardiovascular diseases	—	—	6	22	51	87	166
	Total deaths	12	4	43	40	98	125	**322**
	Influenza and influenzal pneumonia	—	—	4	5	19	22	50
27.1.51	Other pneumonias	—	1	2	3	7	13	26
	Bronchitis	1	—	1	5	15	13	35
	Cardiovascular diseases	—	—	7	18	36	52	113

in number, exceeded the highest number of deaths experienced in the worst week of the 1918–1919 epidemic (638). In the next week (ending January 13, 1951) the deaths from all causes rose to 894. This was the peak and the epidemic then gradually declined till, by the end of January, conditions approached normal.

The causal agent was shown to be *Virus A prime* type which was also associated with an outbreak in the Tyneside area some weeks earlier. The method of conveyance of infection to Merseyside is unknown and early cases and deaths occurred in all parts of the Liverpool city area about the same time.

Climatic factor.—The epidemic started during a period of intensely cold weather, the

coldest spell in Merseyside for a number of years, the sequence of events being, cold weather, influenza epidemic with large numbers of cases followed by a high death rate. As milder weather supervened, the epidemic declined. This has been set out in Table II.

TABLE II.—SEQUENCE OF EVENTS IN RELATION TO CLIMATE, SICKNESS AND DEATHS

Week ended	Weekly mean temperature in ° Fahrenheit	Total deaths	Respiratory deaths	National Health Insurance new sickness claims
2.12.50	41·7 (0·9)*	214	42	3,110
9.12.50	39·5 (2·6)	205	38	2,958
16.12.50	34·7 (7·0)	217	43	2,518
23.12.50	35·9 (5·6)	244	48	1,571
30.12.50	33·8 (7·5)	301	60	9,806
6.1.51	36·6 (4·4)	658	301	22,320
13.1.51	40·0 (0·9)	894	476	11,447
20.1.51	44·1 (+3·4)	581	286	6,081
27.1.51	38·7 (1·9)	322	118	3,704
3.2.51	36·8 (3·7)	282	89	3,792

*Figure in brackets indicates the amount the weekly mean temperature was below the average of previous 20 years.

TABLE III.—DEATHS FOR 6 WEEKS EPIDEMIC PERIOD IN AGE AND SEX GROUPS WITH PERCENTAGES OF TOTAL DEATHS IN EACH AGE GROUP

	Under 1 year	1–14	15–54	55–64	65–75	Over 75	Totals
Males	59	18	207	288	471	415	1,458
Females	41	23	154	214	453	657	1,542
Totals	100	41	361	502	924	1,072	3,000
Percentage of total deaths	3·33	1·37	12·04	16·73	30·80	35·73	

Age and sex—deaths.—Table III shows that during the six weeks epidemic period a total of 3,000 deaths occurred as compared with an average of 1,292 deaths in the corresponding weeks for the previous five years. The number of females dying during the epidemic was 1,542 as compared with 1,458 males. It should be noted that this predominance was due to a greater number of deaths of aged women in the 75 years and over age-group, probably reflecting to some extent that women live to greater ages than men, but more important as it underlines the need for some definite policy in dealing with epidemic influenza. More aged women live by themselves in the community and special arrangements must be made for their care in an epidemic of this type.

Table III also shows the high incidence of deaths in the older age-groups, 66·5% of the deaths during the epidemic occurred in persons over the age of 65 years. The main causes of death in the elderly were respiratory and cardiovascular sequelæ to the virus infection. Pneumonias with profuse secretion and toxic myocarditis were frequent causes of death. Several practitioners mentioned the occurrence in a few younger patients of a marked cyanosis similar to that reported in the 1918–1919 epidemic. The disease mainly affected individuals in adult life; and infants and children to a lesser extent.

TABLE IV.—WEEKLY DEATH RATES PER MILLION OF POPULATION AS COMPARED WITH CORRESPONDING WEEK OF 1950

Week ended	Rate per 1,000,000 population	Corresponding week 1949–50
23.12.50	15,898	12,916
30.12.50	19,612	14,886
6.1.51	42,872	11,268
13.1.51	58,249	11,798
20.1.51	37,855	11,136
27.1.51	20,980	14,498

Table IV shows the weekly death rates per million of the population as compared with corresponding weeks of 1949–50 showing the considerable increase during the epidemic.

TABLE V.—INFLUENZA EPIDEMIC LANCASHIRE AND CHESHIRE POPULOUS AREAS

	Average weekly death rate per million population for six weeks ended 27.1.51		Average weekly death rate per million population for six weeks ended 27.1.51
Liverpool	32,594	St. Helens	28,541
Birkenhead	30,977	Southport	32,611
Wallasey	34,646	Manchester	23,705
Bootle	28,139	Preston	25,775
Chester	26,715		

Table V sets out the average weekly death rate per million for the six epidemic weeks for a number of centres of population in Lancashire and Cheshire. It will be noted that the Merseyside towns had the highest death rates. The high death rate of Southport was probably due to the relatively higher proportion of elderly persons resident in this town.

Discussion.—The main difficulties which the health and sickness services had to face were threefold.

(1) *Lack of accurate information.*—As influenza is not a notifiable disease no accurate morbidity data were available and this made accurate estimation of the magnitude of the epidemic impossible. Some information on this would have been most helpful in the early stages of the epidemic. I would suggest that when influenza is prevalent, if the Ministry of National Insurance could agree to let the Medical Officer of Health for the area have some idea of the day-to-day medical certificates with the nature of the incapacity diagnosed as influenza, this would be of assistance. This source of information would have the virtue of saving the general practitioners extra work.

(2) *Overwhelming calls on general practitioners and the domiciliary services.*—During the epidemic the general practitioners exerted themselves to meet the emergency and worked unceasingly to alleviate the sufferings of their patients. For example, one doctor and his assistant in an industrial practice who kept records during the epidemic saw between them 1,821 new cases diagnosed as influenza among which 43 cases of pneumonia occurred. Of the influenza cases seen by these two doctors only 6 were admitted to hospital. Similarly the home nursing and domestic help services were taxed to their utmost. During January 1951 the number of new requests for the services of a district nurse in Liverpool was 3,741 as compared with 2,420 in 1950 and new requests for domestic help were 398 in 1951 as compared with 262 in January 1950.

(3) *Difficulty of gaining admission to hospitals.*—Owing to lack of information no special arrangements were made by hospitals in Liverpool early in the outbreak to cope with the sudden demand for hospital beds. However, it did not take long for the Medical Superintendents of the former municipal hospitals to realize the true state of affairs and on their own initiative they arranged for the provision of additional hospital accommodation for complicated cases of influenza and for cases where social need required the admission to hospital. There is no doubt that the action of these medical superintendents was an important factor in reducing the mortality from this epidemic.

The influenza outbreak in Liverpool showed us that the disease can strike so suddenly that the Health Services must be prepared beforehand to deal with the epidemic. Additional assistance for practitioners, domestic helps and district nurses should be planned, and above all a definite hospital policy formulated to provide in the event of an outbreak as many beds as possible for influenza cases in need of hospital care. Medicine must subserve the needs of the community and in an influenza epidemic the need for every bed to be used to save life is paramount.

Mr. B. Benjamin: Since influenza is not a notifiable disease we are forced to measure incidence by reference to deaths. A study of the weekly deaths in the Great Towns of England and Wales, London, Birmingham and Manchester in successive winters from 1920 leads to the question "what is an epidemic of influenza"? Sharp seasonal rises in influenza deaths occur in most winters (not since 1919 have these periods of higher mortality persisted beyond the 20th week of the year); the deaths rise rapidly to a peak and as quickly fall away. Are these all epidemics? Are they seasonal rises in a disease which conveys such short immunity that the proportion of susceptibles is high and spread, when favoured by weather or other causes, inevitably explosive in character? There is a parallel with poliomyelitis although here the high proportion of susceptibles may be not so much due to short immunity as to a low attack rate. Even on conventional standards when is influenza regarded as reaching epidemic incidence? Drs. Logan and Mackay in their *Lancet* paper (1951, i, 284) appear only to have taken those years in which weekly deaths in the Great Towns at any time exceeded 600 deaths a week, e.g. they ignore 1930–31 and 1939–40. Such a selection is of course quite reasonable so long as it is not necessarily implied that there is anything essentially different about influenza in the omitted years. Such a false distinction has, I think, led to much frustration on the part of those who have sought some essential periodicity about their own arbitrarily defined epidemics. For in a sense influenza is always epidemic and in many respects each outbreak is a law to itself.

It is necessary to emphasize also that the disease does not always behave in local areas in the same way at the same time. Epidemic curves for the country as a whole are composite curves of local experiences and are therefore considerably influenced by variations of timing and extent of spread between one locality and another. Thus the 1923–24 and 1926–27 curves for the Great Towns are much influenced by the earlier rise in London than

in Birmingham or Manchester. A much sharper peak is produced in 1921–22 and 1928–29 when there was less difference in timing.

This is probably the mechanism by which some cause, perhaps the improved communications suggested by Logan and Mackay, may have produced the increased steepness of national epidemic curves in more recent years. Since 1931 there has been a tendency for the widely separated towns of Birmingham, Manchester and London to give mortality peaks closer together in time and thus to influence the production of sharper curves for the Great Towns. In the most recent epidemic London, Manchester and Birmingham exceeded the mortality of 1943–44, but the 1936–37 level was not reached by London. The highest weekly mortality rates reached this year were per million—

London	41·6	Birmingham ..	67·3
Manchester ..	102·2	Great Towns ..	60·0

In Fig. 1 I have shown the 1950–51 figures for London in greater detail. The continuous line at the top relates to deaths *over* 55. The lower continuous line with circled

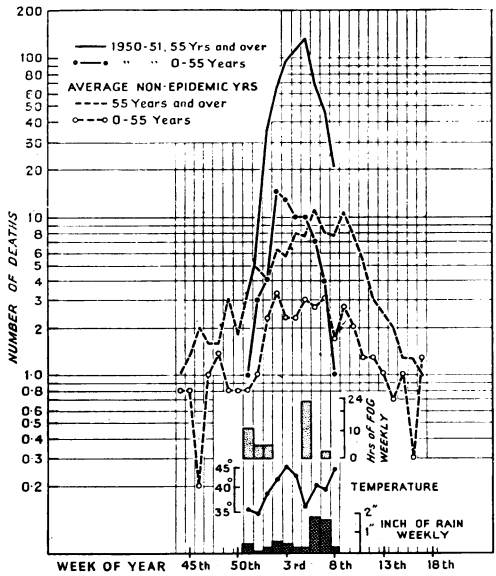


FIG. 1.—Weekly deaths from influenza, London, 1950–51, and weekly average in non-epidemic years, 1945–48.

points relates to deaths *under* 55. The broken lines are the averages for the corresponding weeks in non-epidemic years—1945 to 1948. I have inserted also temperature, rainfall and fog.

It has been generally noted that most of the mortality was at very advanced ages.

For the weeks December 23, 1950, to February 24, 1951, the age distribution of influenza deaths in London was—

Age	Per cent		Age	Per cent	
0–4	1·3		55–64	16·5	
5–14	—		65–74	32·0	89·5
15–24	0·3	10·5	75–	41·0	
25–44	2·5				
45–54	6·4				

The under 55 deaths rose to a peak regardless of higher temperature and absence of fog—as might be expected of true influenza. The over 55 deaths peaked at minimum temperature and maximum fog, i.e. these deaths were, if due to influenza, mainly exacerbations of chronic respiratory disease; or a higher influenza case-fatality in a population with a heavy loading of chronic respiratory disease; or both. You will notice too from the average curves that it is usual for the rise in over 55 deaths to reach a maximum later than in younger persons.

The incidence of influenza as measured by deaths rose in younger persons to 5 times the average "non-epidemic" level and in older persons to 10 times the average level, 1945–48.

Dr. Norman R. Grist,[1] *Glasgow*: Routine serological testing of consecutive admissions to pneumonia wards in Knightswood and Ruchill hospitals, Glasgow, provided data shown in Fig. 1, where the results of complement-fixation tests of paired sera against influenza A soluble antigen are related to certain weekly returns of the Registrar-General for Scotland. A fourfold rise in titre was held to indicate active infection with influenza A virus, and such cases were detected only during a period of six weeks beginning in the last week of 1950. Where no fourfold rise in titre occurred but at least one serum gave a titre of 32 or more, the case was considered as having had recent experience of influenza A infection; no such cases were found during 1950, but they appeared in the first week of 1951. Fig. 1 shows good agreement between the trends in these groups and the graphs of notifications of acute primary pneumonia and deaths from non-tuberculous respiratory disease in Glasgow. During the period when these notifications had approximately doubled, about two-thirds of the "pneumonia" admissions showed evidence of active or recent influenza A infection.

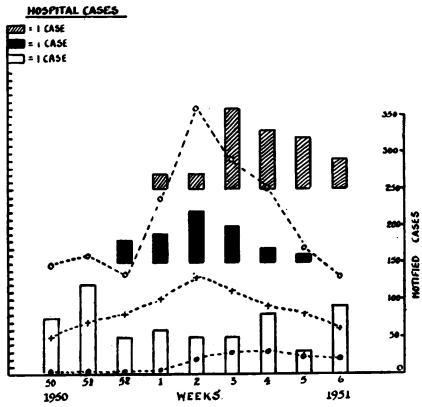


FIG. 1.—Pneumonia in Glasgow. Hospital cases (grouped by admission dates). Shaded = "Recent" Influenza A. Black = Acute Influenza A. White = Negative for Influenza.

Registrar's return: ○———○ = Acute primary pneumonia. ●———● = Acute influenza pneumonia. +———+ = Deaths from "Respiratory diseases (other than tubercular)".

FIG. 2.—Dates of onset of respiratory illness of first fourteen "Pneumonia" admissions with "Acute" Influenza A.

In an attempt to date the beginning of the epidemic in Glasgow, the dates of earliest symptoms of the first fourteen cases with evidence of active influenza infection were determined (Fig. 2). One case, shown in the diagram by cross-hatching, had a biphasic illness, but the nature of the symptoms and the serological response suggested that the influenza infection developed on December 26. December 21, therefore, was the earliest date of onset in this group of cases, whose experience of influenza probably reflected that of the general community of Glasgow.

Dr. R. E. Hope Simpson, *Epidemiological Research Unit, Cirencester*: The main impact of the 1951 epidemic of influenza struck the Cirencester area of Gloucestershire in January and February. The busiest day in the general practice was January 20. The pressure of the work limited the studies of the Epidemiological Research Unit and the analyses are not yet complete, but the following observations seem worthy of record. Our chief interest was in the method of transmission of influenza.

Answers were sought to these questions:

(1) The peak of the epidemic appears at different times in different places, a fact that has been used as evidence of the route of transmission of the disease. For example, it has been said that the influenza came from Scandinavia to Newcastle and the north-east coast and spread south and west from these areas. *Is this a justifiable conclusion* ?

In order to test this, the peak week of the epidemic in the schools within eight miles of Cirencester was recorded. These schools even in this small locality provided epidemic peaks covering much the same period as those cited from different areas of the whole country. *Dates of maximal incidence do not therefore provide good evidence of the route of spread.*

(2) Against some diseases there is already in the community a number of immunized people, so that the disease produces its heaviest effect in certain age-groups. In measles, for example, those under 6 months often carry a temporary immunity and those over 15 years of age are usually immune because they have had an attack of the disease, so that an epidemic will fall most heavily between these ages. *Does the population carry any such immunity against influenza ?*

To test the matter 100 families into which influenza had been introduced were studied. These 384 persons formed a fair age sample of the population both of the practice and of the country as a whole (Table I). It will be seen from this table that, apart from a high

[1]In receipt of a grant from the Medical Research Council.

TABLE I.—THE AGE DISTRIBUTION OF 100 FAMILIES WITH INFLUENZA (SAMPLE) RELATED TO THAT OF THE GENERAL PRACTICE FROM WHICH IT IS DRAWN AND TO THAT OF THE CASES OF INFLUENZA AND ESCAPES WITHIN THE SAMPLE

Age decades Years	Percentage of persons in each decade in: Practice	Sample	Cases	First cases	Subsequent cases	Escapes
0– 9	18·7	26·0	28·1	25·6	29·4	15·0
10–19	10·6	12·5	11·1	9·4	12·1	20·0
20–29	13·7	11·2	9·9	11·1	9·2	18·3
30–39	13·7	15·1	15·7	13·7	16·9	11·7
40–49	13·3	14·3	14·5	18·8	12·1	13·3
50–59	10·4	10·4	9·6	11·1	8·7	15·0
60–69	9·9	5·7	5·4	6·8	5·8	3·3
70–79	6·6	3·4	3·7	3·4	3·9	1·7
80–89	2·8	1·3	1·2	—	1·9	1·7
90–99	0·2	—	—	—	—	—
Total No. of persons	3,930	384	324	117	207	60

incidence of escapes in the second and third decades, the cases and escapes were evenly scattered over the whole age range. Moreover, the attack rate was high—844 per thousand amongst the whole group, or, without the 117 first day cases, 775 per thousand amongst remaining susceptibles. Four patients, all over 75, died. *The high attack rate and the unspecialized age distribution together point to a general lack of immunity against* 1951 *influenza in the population studied.*

(3) Measles tends to be caught at school and brought home by the school child, a fact reflected in the ages of the primary and secondary cases when the disease is studied in the home. *Does the school child bring influenza home from school?*

TABLE II.—THE PERCENTAGE DISTRIBUTION OF CASES IN VARIOUS AGE GROUPS AS PRIMARY OR SECONDARY CASES IN THE HOME TO SHOW THE EFFECT OF THE SCHOOL-AGE CHILD

Susceptibles		Measles	Influenza
Below school age	Primaries	20	32
	Secondaries	80	68
School age	Primaries	80	32
	Secondaries	20	68
Above school age	Primaries	0	38
	Secondaries	100	62

(The figures in influenza refer to zero day cases and subsequent cases.)

From Table II it is seen that 80% of the school-age cases come down in the first generation of measles in the home and only 20% in the second. The table shows no such state of affairs in influenza. In Table I also it will be seen that neither the first cases in the family,

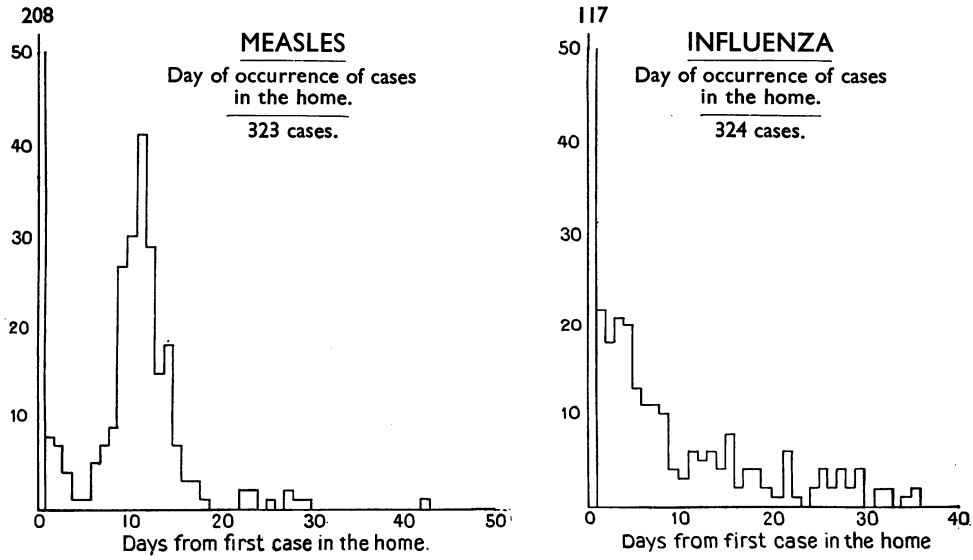


FIG. 1.—The day of occurrence of subsequent cases in the home in relation to the first case in measles and influenza.

nor the subsequent cases when analysed separately, show any special age preference. It appears, therefore, that *the school child does not play a preponderant rôle in bringing influenza into the homes.*

(4) In studying the transmission of diseases inside a particular community it is helpful to plot on a chart the number of cases occurring on each day, and for the home environment the first case in each family is plotted on day 0. Fig. 1, for example, shows that the curve for measles falls rapidly away from the zero day and rises again in a steep wave with its mode on day 11, showing at a glance that secondary cases are being caused by the primary cases in the home. *Is influenza also transmitted inside the home?*

The chart for influenza in Fig. 1 shows no such picture. The susceptibles fall rapidly and fairly steadily away from the zero day. *There is therefore no evidence that the* 1951 *epidemic of influenza was being transmitted inside the family.* Table III shows cursorily the scatter of successive cases in families of different size.

TABLE III.—RANGE OF DAYS OF OCCURRENCE OF SUBSEQUENT CASES OF INFLUENZA MEASURED FROM THE FIRST CASE IN FAMILIES OF VARIOUS SIZES

No. of persons in family	No. of families	Range of days of occurrence of : 2nd Cases	3rd Cases	4th Cases	5th Cases	6th Cases
2	20	1–13	—	—	—	—
3	27	0–21	1–20	—	—	—
4	24	0–26	1–29	2–30	—	—
5	17	0–16	0–24	3–31	3–35	—
6	9	0–13	0–15	0–19	2–27	5–29

Here then is an epidemic of a disease with a very high attack rate and against which there appears to be little immunity in the population, which the school child does not bring home from his school and which does not appear to be transmitted inside the home. I am unable to make any positive suggestions as to the nature of the transmission but these results emphasize the need for further detailed studies including intimate knowledge of small populations.

There is always the problem of the identity of the disease. Were we in fact dealing with the same disease as that described in other parts of the country? To attempt to ensure this we obtained sera from 69 patients of which 81·2% gave a positive complement-fixation test for influenza virus A. This result together with the similarity of the clinical picture confirms that we were dealing with the same epidemic.

(In the course of the discussion **Dr. Hope Simpson** made the following observations.)

Doctor Massey, Chief Medical Officer for the Ministry of National Insurance, has shown a chart of the spread of peaks of influenza from east to west across the insurance districts of Yorkshire. I fully believe that these charts are accurate and that the peak did come at a later date in the west than in the east, but when we say the disease spreads from east to west, what in detail do we picture? There are some most interesting things about that chart. For example, big cities such as Leeds, which are surely in much more early and frequent communication with, for example, Newcastle and Sweden, reached their peak later than most of the small country districts around. The "spread" is roughly geographical and not as one would expect along the lines of communication.

Dr. Alick Isaacs; The World Influenza Centre has received a number of influenza virus strains from different parts of Europe and of this country, and almost all have been A-prime strains. Our investigations are by no means complete but it is already clear that the situation with influenza 1951 is not so simple as it was in 1949. At that time, Chu, Andrewes and Gledhill showed that the virus responsible for influenza in Europe was a single antigenic sub-type, suggesting a spread of virus from a single focus—in Sardinia. We now know that more than one sub-type of influenza A-prime virus has been isolated from the 1951 epidemic and it may be that there is more than one focus from which the epidemic started. We hope to have more evidence on this shortly.

Dr. M. Mitman compared the duration of influenzal morbidity among resident and non-resident staffs of hospitals. To the general practitioner, who certified the disability of non-resident staff, disease was measured in weeks—one, two, three, etc.; to the resident medical officer, who certified the disability of resident staff, illness was measured in days—7, 8, 9, etc. If certification by days were introduced, an enormous saving in time lost to the country by illness could be effected.

He suggested that an important contribution to the high death rate from all causes which accompanied the high mortality from influenza was cryptic influenza among the senile

and chronic sick. Among them, clinical symptoms of influenza were often minimal—little or no pyrexia, anorexia, malaise and a deterioration in their general condition, which was attributed to a deterioration in their senile or chronic illness. Dr. Semple's tables appeared to him to support this view.

Dr. R. E. Smith said that in hospital patients during the recent epidemic a new feature appeared to be pain in the neighbourhood of the joints so that movement was painful and the pain moved from joint to joint as in acute rheumatism, nevertheless no cardiac complications ensued.

The B.S.R. was sometimes raised and sometimes it was normal and all cases took an indefinite time to settle, many having pains for over two months. A typical case was a man aged 41 who had "flu". Pain in the chest followed pain in the right knee and elbows and wrists. This gradually subsided. His B.S.R. was 8 on February 20, 45 on March 1, 90 on March 7, 52 on the 14th, 38 on the 21st and 5 on the 29th.

Dr. J. L. Burn, *M.O.H. Salford,* mentioned that the mildness of the epidemic in Salford contrasted sharply with that of Liverpool which was only 30 odd miles away.

Only 49 deaths were ascribed in Salford to influenza—yet, from calculations made from the reports of 20 general practitioners, factories and schools, it was ascertained that probably over 100,000 people out of a population of 180,000 had had some illness consistent with the diagnosis of influenza.

The disease had a sharp onset with headache, sore throat, "feeling cold", cough, whilst pain in limbs and dizziness were common. The epidemic appeared to start about ten days after Liverpool and about two days before Manchester. The progress of the subsequent events of the epidemic were remarkably similar, yet so few died. Infants seemed immune; with very few cases in the 2–5 group. To the old it was a "death-hastener".

Unfortunately, samples for the virus had not been collected. In one case of the only possible exposure to infection, the incubation period was exactly 36 hours. His enquiries showed a bewildering number of "remedies"—some practitioners used chloromycetin with "dramatic effect", others found it valueless.

Points of public health importance emerged; firstly, that some of the doctors' surgeries in industrial areas were obviously unsuitable as a place for patients and their relatives to wait in in times of epidemic. Group practice (or health centre) accommodation with proper waiting room accommodation was a matter of some urgency. Secondly, a bed bureau for a group of hospitals was necessary so that patients and/or nurses could be switched readily to those hospitals inside or outside the group with vacant beds; it was no use sending patients to crowded hospitals where half the staff were themselves suffering from influenza. Thirdly, the stock of nursing requisites possessed by the home nursing service should be adequate to meet needs on a fairly large scale.

A sad sight was the pathetic queues of pale cold people waiting at the fuel depots. Some medical practitioners blamed the lack of first-class protein for the generally slow convalescence.

[*June* 15, 1951]

MEETING HELD AT NATIONAL INSTITUTE FOR MEDICAL RESEARCH, LONDON

The 1951 Influenza Viruses

By A. ISAACS, M.B., Ch.B.

National Institute for Medical Research, Mill Hill, London

THE World Influenza Centre in London works in collaboration with Regional Laboratories in a large number of countries throughout the world. During an influenza epidemic, regional laboratories keep us informed at Mill Hill of the severity and progress of the infection. At the same time they try to isolate strains of virus and send them to the World Influenza Centre. Our task is to compare the strains isolated from different laboratories, so that we can get some idea of where an epidemic arises and how it spreads. The principle involved is essentially the same as that in tracing the source of an outbreak of typhoid by serological typing of the strains. The picture obtained by this method is essentially incomplete but no epidemiological account of influenza can ignore the evidence provided by the virus strains.

There are a number of serological tests which can be used to classify influenza virus strains. They show that there are two main types of influenza virus, A and B, which are quite unrelated serologically and epidemiologically. Of these the most widely used is the antihæmagglutinin test.